-Supporting Information-

Core-composite mediated separation of diverse nanoparticles to purity

Chandra S. Bhatt[a], Bharathkumar Nagaraj[b], Deepanjan Ghosh[c], Sureshkumar Ramasamy[c], Ranjit Thapa[d], Sreekar B. Marpu[e] and Anil K. Suresh*[, a]

[a]*Bio-Nanotechnology Laboratory, Department of Biotechnology and* [d]*Department of Physics, SRM University-AP, Amaravati-522502, India.*

[b]*Department of Biotechnology, Faculty of Science and Humanities, SRMIST, Kattankulathur, Chennai 603203, India.*

[c]*Biochemical Sciences Division, National Chemical Laboratory, Pashan Road, Pune 411008, India.*

[e]*Department of Chemistry, University of North Texas, Denton, TX 76201, USA.*

Address Correspondence to Anil K. Suresh, e-mail: anil.s@srmap.edu.in

Detailed synthesis of various monodispersed nanoparticles used in our studies

1. Synthesis of Monodispersed Gold Nanospheres (AuNPs)

For the synthesis of monodispersed gold nanoparticles, briefly, 750 µL of trisodium citrate (25.7 mM) was added to the boiling 50 mL of $HAuCl^{4-}$ (294.3 µM). Transformation of colour from light blue to red, and within two minutes indicating the formation of Au nanospheres.

2. Synthesis of monodispersed Silver Nanospheres (AgNPs)

Briefly, 45 mL of solution containing $NaBH_4$ (1 mM) and trisodium citrate (3.55 mM) were heated to 60 ºC for 30 minutes under dark with vigorous stirring, followed by dropwise addition of 5 mL of $AgNO_3$ (4 mM) and subsequently raising the temperature to 90 ºC. After attainment of the temperature to 90 ºC, pH of the solution was adjusted to 10.5 using NaOH (0.1 M), and continuely heated further for 20 min until colour changes to yellow.

3. Synthesis of monodispersed Platinum Nanoshperes (PtNPs)

Initially, platinum seeds of 5 nm diameter were prepared by adding 18 mL of 0.2% solution of $HPtCl^{4-}$ to 232 mL of boiling water. Within a minute, 5.5 mL solution of 1% SC and 0.05% CA was added, followed by 30 sec interval. Quickly 2.77 mL of 0.08% $NaBH_4$ was injected. The seed solution was heated for 10 min, later cooled to room temperature. Finally, 25±5 nm platinum nanospheres were prepared by adding 1 mL platinum seed solution to 29 mL of water, followed by addition of 45 µL of $HPtCl^{4-}$ (0.4 M) and 0.5 mL of solution containing 1% sodium citrate and 1.25% ascorbic acid under stirring. Temperature was slowly raised to boiling at the rate of 10 ºC/min.

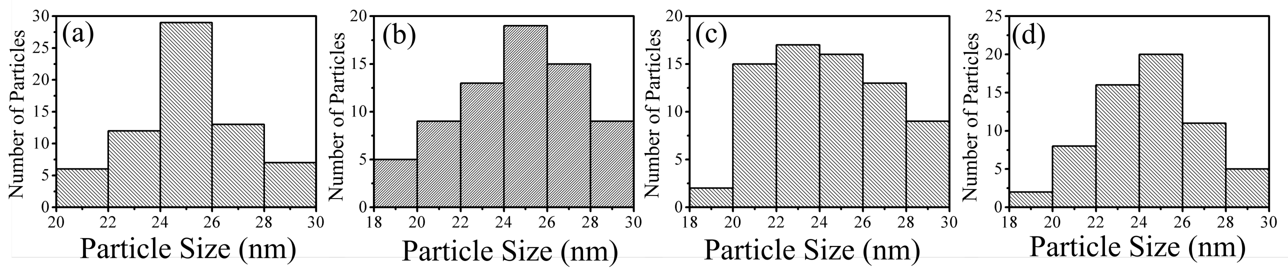


Figure S1. Histogram size distributions calculated by counting ~70 particles from various TEM images for the various cores of nanoparticles used in our studies. (a) IONPs (b) AgNPs (c) AuNPs and (d) PtNPs. Average size distribution of all the nanoparticles is 25±5 nm.

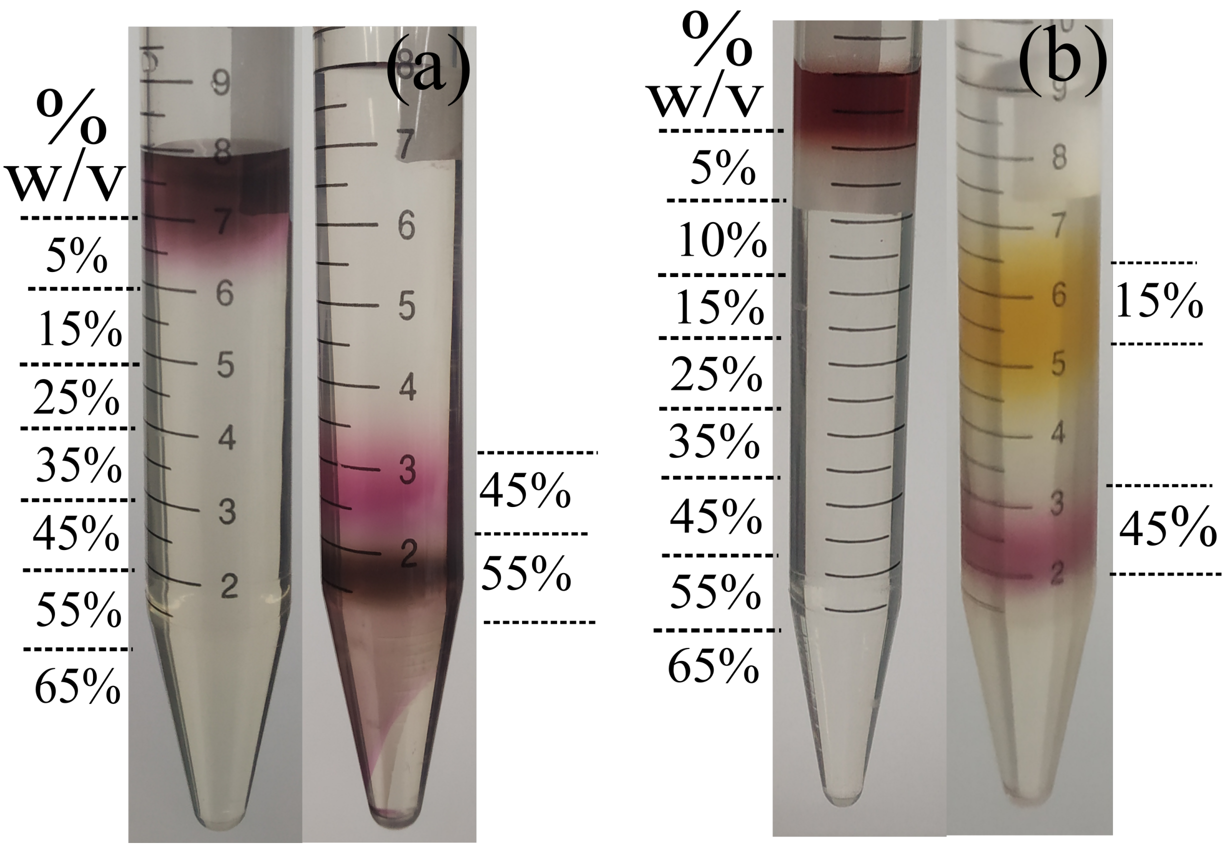


Figure S2. Separation of dual core-compositions of combinations; AuNPs *plus* PtNPs and IONPs *plus* AuNPs before and after separation. (a) Photograph of the mixed parent AuNPs *plus* PtNPs showing dark grey color before (left) and after (right) separation showing two distinctive colored bands for the representative nanoparticle. (b) Photograph of the mixed parent IONPs *plus* NPs showing brown color before (left) and after (right) separation showing two colored distinctive bands for the separated nanoparticles.

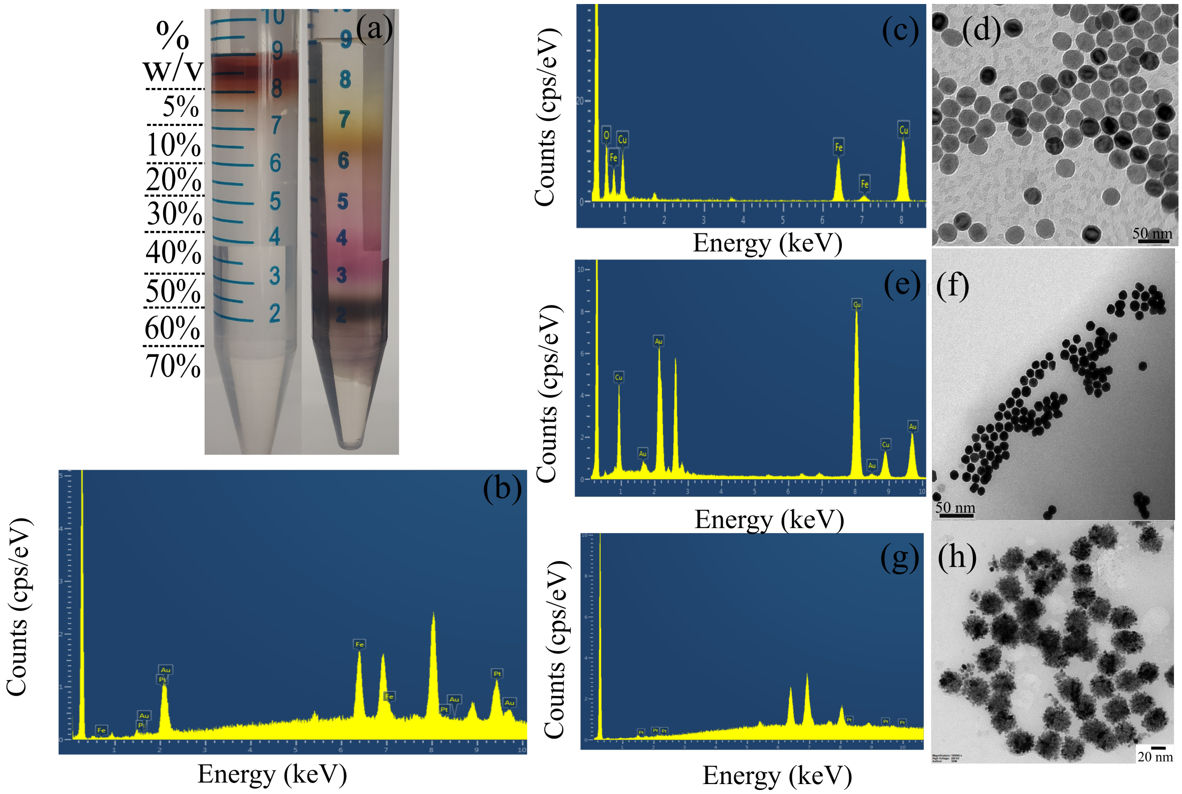
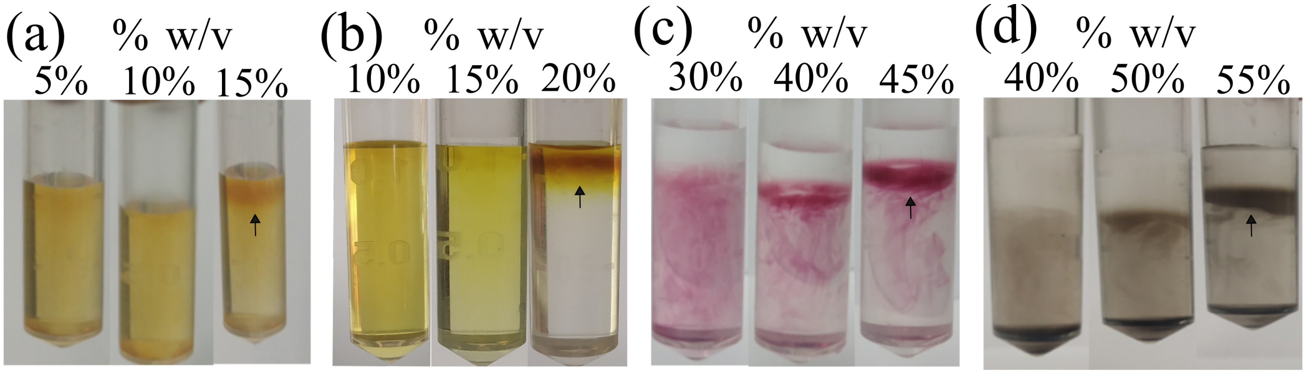


Figure S3. Characterization of triplicate core-compositions of iron oxide *plus* gold *plus* platinum nanoparticles before and after separation. (a) Photograph of the mixed nanoparticle showing dark brown color before (left) and after (right) separation showing two distinctive colored bands for the representative nanoparticle. (a). (b) EDS of the parent nanoparticles showing strong signals from IONPs, AuNPs and PtNPs. (c, e, g) EDS of the purified IONPs, AgNPs and PtNPs showing strong independent signals. (d, f, h) Are TEM images of the purified IONPs, AuNPs and PtNPs.



Optical photograph images of the various nanoparticles used in our studies showing the centrifuged sample at different percent gradients to determine the impedence gradient. (a) IONPs (b) AgNPs (c) AuNPs and (d) PtNPs. The impedence gradients were determined to be 15%, 20%, 45% and 55% for IONPs, AgNPs, AuNPs and PtNPs respectively, indicated using arrows.

Table S1. Density of the metal nanoparticles that are used in our studies for separation.

Metals	**Density** (ρ) kg/m^3
Platinum	21400
Gold	19320
Silver	10490
Iron	7850

Table S2. Viscosities and densities of the sucrose at various percent gradients.

% Sucrose (w/v)	**Viscosity (μ) kg/m^3**	**Density (ρ) kg/l^3**
0	1000	0.998
5	1144	1.018
10	1333	1.038
15	1589	1.059
20	1941	1.081
25	2442	1.104
30	3181	1.127
35	4314	1.151
40	6150	1.176
45	9360	1.203
50	15400	1.230
55	28002	1.258
60	58037	1.286
65	146090	1.316
70	480060	1.347
75	2323000	1.379